



Learning Ecology through Endangered Species

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Overview

Animals have always held a very special place in my heart! In Kindergarten I overheard my father say he was going to spray our bushes to kill the snails. I ran and grabbed my mom's purse, went to the bushes and proceeded to hand pick each snail up and put it in the purse. When I had gathered all I could find I went to the curb and set each one of my "friends" free in a nice little row. I learned three valuable lessons that day! First, I was not able to save all of my "friends." Some got run over, some stayed in the bushes and were sprayed. Second, I felt a wonderful warmth inside of me because I was able to save some of these beautiful creatures with magnificent shells. Third, always ask your mom before you borrow her purse!

In elementary school I lived in a house that was located in the middle of a trailer sales and rental lot. My first job in our family business was to make friends with any children who came to the lot and entertain them. My animals were the best entertainment! Of course we had a dog, cat, parakeet and tropical fish tank, but my playmates were most interested in my pet goat, chickens, rabbits, homing pigeons and baby alligator. My love and fascination of animals started at a very young age and has continued to grow into a deep respect and awe of the creatures who share this home we call earth. Recently I have learned that we must go beyond respect and awe to a place of personal responsibility and action. We must seek answers to difficult questions such as: What can we do to stop climate change which affects all living things? What is our role in reducing air and water pollution? Why do animals become endangered? What part can we play to keep endangered species from becoming extinct, and threaten species from becoming endangered?

As a young child I understood I must do something to save my "friends" the snails, but my choice did not have a good outcome because my little brother found delight in the sound of crushing shells as he stomped on the snails and the curb was not a good place to relocate them. A better solution may have been to plead with my Dad not to spray them or put them on my neighbors' bushes (I was too young to leave my yard.)

This unit is written to help my students not only build an understanding of the interdependence of plants and animals and how humans affect ecosystems but to go beyond basic knowledge to personal responsibility and action. I want to empower the students to become part of the solution to help save animals from extinction through doing something. It is not enough that my students "become acquainted with what happens when changes occur when the environment becomes overpopulated and the use of resources increases" (North Carolina Standard Course of Study) but that they see solutions and the part they can play in bringing about

needed change! I want to raise my student's awareness of how climate change affects all living things, ways that they can personally reduce global warming and become change agents for a healthier world!

Demographics

J.H. Gunn Elementary School is a suburban elementary school serving students K-5. The school is located in Charlotte, North Carolina in the urban school district of the Charlotte/Mecklenburg School System, which is the twenty-second largest school system in the nation. J. H. Gunn has a multicultural population of 761 students and is an English as a Second Language (ESL) designated site. The ESL Program serves approximately twenty-five percent of our student body. Our school also serves many students with special needs including physical, mental and behavioral challenges. Seventy-seven percent of our students receive free or reduced lunch making it a Focus and Title I school. The school has been an integral part of the J.H. Gunn community, an integrated medium-low income neighborhood (African American, Hispanic, Caucasian and others), for over 75 years.

I am the full time Science Facilitator at my school. I transformed a standard classroom into a Science Lab. The Lab has 6 tables for group experiments and cooperative working groups as well as a Media Viewing Space (rugged area where a computer connected to a LCD, overhead and TV is located). The Science Lab experience is considered a "Special" class on the same level as Art and Computer classes. Every student in the school comes to the Science Lab for a forty minute lesson one time a week during the school year.

I teach Science using the North Carolina Standard Course of Study (NCSCoS) and appropriate teaching methods, resources and strategies related to designing effective science learning experiences for my students. For most lessons I use the Five E's (Explore, Engage, Explain, Elaborate, and Evaluate) in planning interactive lessons. I have discovered many excellent interactive science web sites where students can perform virtual experiments. Viewing these web sites as a group has had a real impact on student learning. Many of the students are lacking in life experiences and the use of the technology gives them background knowledge to be able to perform their own discovery experiments.

Rationale

This is the first year that the state of North Carolina has elevated the fifth grade Science test as a "gate-way" test. The Science End of Grade (EOG) test has been placed on the same level as Reading and Math EOG's. Schools are often judged by the public on how the students score on the EOG's. These facts have had a great impact on the teaching of Science at the elementary level. Testing our students in science is stretching our teaching of science!

During the second quarter of fifth grade I am assigned to teach Ecosystems. The competency goal is: "The learner will conduct investigations to build an understanding of the interdependence of plants and animals." For the last few years I have taught Ecosystems by dividing North Carolina into 13 regions and having cooperative learning groups research the ecosystem, prepare a poster and give a report to the entire class

about their region. This has been marginally successful. As a reflective teacher I was searching for a way to study this goal in a highly motivational way. Dr. John P. Wargo, professor of Environmental Risk Analysis and Policy at Yale University, and I discussed looking at the topic through the lens of endangered animals. I want my students to first become aware of the problems of species that are endangered and then to play an active role in becoming part of the solution.

My objectives for this unit include describing and comparing several common ecosystems as well as identifying and analyzing the functions of organisms within the population of the ecosystems. My students will also be able to explain why an ecosystem can support a variety of organisms and determine the interaction of those organisms within the ecosystems. The students will be able to discuss and determine the role of light, temperature, and soil composition within an ecosystem's capacity to support life. Students will also determine how materials are recycled in nature. As students study ecosystems they will become acquainted with what happens when changes occur such as the environment becomes overpopulated and the use of resources increases. Students will explore ecosystems in our local environments, focusing on the interactions between living and nonliving things. They will look at food webs within ecosystems and describe the relationships among producers, consumers, and decomposers while examining the energy flow from one organism to another in a food web.

This unit will focus on the effect human population growth and human activities play in threatening the earth's habitat and capacity to sustain life. Students will learn the goal and objectives in addition to ways to become good caretakers of our environment through the lens of human impact on these endangered animals.

Background Information

From the time we awake until we go to bed our activities, our choices and situations imposed upon us have an impact on the world around us. What we eat, how we travel, what we buy, how we heat and cool our spaces and many other decisions we make in a day all affect the environment, which in turn has an impact on populations of animals and plants. Environmental challenges such as acid rain, depletion of the ozone layer, greenhouse effect leading to climate change, hazardous waste, destruction of habitats and air and water pollution, adversely affect animal populations (including human beings!)

Ecology is the study of living things in their natural environment or surroundings which includes both living and non-living entities. Ecology investigates how people, plants and animals live with and affect each other and their environment. Everything we do to our environment will have an effect back on us, as well as on every other living thing sharing our environment with us, creating a vast environmental web.

All living things are dependent on our environment for the essentials of life. The basis of all life on earth is the sun. It provides plants and animals with the energy they need to live. Winds are generated by heating the earth's land masses and the air above them. It powers the water cycle by evaporating water into the atmosphere. Without the sun, life on earth could not exist.

The sun's energy is not evenly spread across the surface of the earth. Polar areas receive far less than equatorial areas. Due to this factor an imbalance is created which drives the winds around the world. There are six major climates which are influenced by distance from the equator, height above sea level and distance

from the ocean. They are polar, mountain, cold forest, temperate, dry, equatorial and sub-equatorial.

Natural climate changes take place gradually over thousands of years and pose no great threat to us at present. On the other hand, human's energy needs are causing an array of environmental problems that can have a devastating impact on our earth. Our ever growing energy demands create real threats to our environment! Some of these threats are rapid climate change and the greenhouse effect, which contribute to global warming.

Sources of energy are divided into two groups, renewable and nonrenewable. Fossil fuels (coal, oil and natural gas) and elements needed for nuclear energy are nonrenewable sources of energy. Wind, water, solar and geothermal energy are renewable resources. Wood is a renewable resource, but we are using it faster than it can be replenished and it is rapidly becoming a nonrenewable source of energy.

Daily we consume energy and often waste energy without a second thought. When we jump in our car to take a drive we are depleting limited oil resources and emitting air pollutants. When we use electricity produced from the burning of fossil fuels we deplete limited coal resources and emit air pollutants.

As we burn fossil fuels for energy, carbon dioxide is released into the atmosphere contributing to the greenhouse effect of trapping the sun's heat and warming the earth. The gases, which can stay in the atmosphere for at least fifty years and up to centuries, are building up beyond the earth's capacity to remove them and, in effect, creating an extra-thick heat blanket around the earth. In February 2007, the thousands of scientific experts collectively known as the Intergovernmental Panel on Climate Change (IPCC) concluded that there is greater than 90 percent likelihood that people are causing global warming. (1)

Many scientist and people believe that in all of human history, climate change is the greatest threat our planet has faced! In addition, the sulfur dioxide, nitrogen dioxide, and particulates emitted from the burning of fossil fuels create smog and acid rain. These forms of pollution adversely affect human health and damage our environment through water supplies, vegetation and wildlife resources.

Ecosystems are made up of a given habitat and its community of plants and animals. The living things within an ecosystem interact with each other and their non-living environment to form an ecological unit which is largely self-contained. Ecosystems come in a variety of sizes and can range from very small to very large. Many small ecosystems can be contained within a larger one. Natural ecosystems are made of both abiotic factors (air, water, rocks, energy) and biotic factors (plants, animals, and microorganisms).

Within ecosystems there are habitats that can also vary in size. In a habitat is where a population lives. A population is considered any group of organisms of one species in a certain area. The group of plants and animals that live in a habitat is a community. Within the habitat, the needs of the organisms are met. These needs are food, water, temperature, shelter, oxygen, and minerals.

Biomes are the largest ecosystems. Each biome is home to a large variety of plants and animals. They are named after the main types of vegetation found in them. Biomes are where several habitats intersect. Biomes are natural occurring environments, although people can create controlled biomes. Within all biomes, habitats, and ecosystems is an energy cycle.

Each living thing on earth needs energy and ultimately the sun is the source of energy within an ecosystem. Organisms in a given ecosystem are linked by their feeding relationships. A food chain is how energy is passed from one organism to another. The organisms in the food chain are producers, consumers, or

decomposers. Plants act as producers by using the sun's energy to produce food through a process called photosynthesis. In this process plants build carbohydrates from water and carbon dioxide, releasing oxygen (light energy is changed to chemical energy). Decomposers and consumers eat other organisms for their food. A food chain is depicted as a single path, but in the real world there is not a straight path, but rather a web of paths. This is because animals often eat a varied diet and so play different roles in a number of food chains. Patterns of feeding link different ecosystems. A food web is made up of interlocking food chains.

Urban expansion and the spread of industry and agriculture are resulting in destruction of important natural habitats. When habitats are destroyed, disturbed or simply disappear the animals that depend on those habitats either have to adapt quickly, if they can, or they will die out. Human activities can lead to smaller plant and animal populations. Habitat loss, pollution, population growth, introduction of non-native organisms, and overexploitation can cause a population of a species to become so small that it cannot survive. A species that is in danger of dying out due to their critically low numbers is called an endangered species. Animals that are most likely to become endangered due to their small numbers are called threatened species. Animals that are gone forever are called extinct.

Rapid habitat loss is the primary cause of species endangerment. Human beings are the strongest forces in rapid habitat loss. As human population and consumption increase, wildlife habitats are converted to homes, schools and roads. Shopping Malls stand where wetlands once existed. Trees are cut down to build homes and supply us with paper. The population growth means more and more people need more food and more land.

Pollution is another way to degrade habitats. Pollutants disposed of improperly, oil spills, trash and plastics find their way into habitats, destroying the balance of nature. Life depends on water for its survival yet we dump toxic chemicals and garbage right into our oceans, lakes, rivers and streams. Water pollution harms animals in both fresh and saltwater environments. Ships pollute our oceans by dumping waste. Large oil spills have occurred that have killed many animals.

Air pollution also contributes to the loss of habitats. Factories, trucks, cars and buses burn fossil fuels adding chemicals to the air (seen as smog) creating acid rain that pollutes both land and water habitats. As our climate warms from the greenhouse effect many animals will become extinct.

Pesticides sprayed on our crops cause threat to many animals. The toxin is first eaten by a herbivore (plant eater). Predators then eat many herbivores and over time build high levels of concentration of these chemicals in their systems. This is called biomagnification, the increase in a persistent pollutant by the food chain. Many of the most dangerous chemicals in the environment are those that are biomagnified. These chemicals are similar in that they are long-lived (persistent) in the environment and not easily broken down into non-toxic components. In addition, these chemicals tend to bond with the fatty tissues of the organism. Chemicals of this kind can disrupt physical functions such as reproduction. An example of this is large birds of prey accumulating the pesticide DDT in their systems causing their egg shells to be so thin that they became endangered.

Humans also deplete wildlife populations by killing or capturing animals for their own use. An example of this overexploitation is the killing of thousands of grey wolves. At one point government agencies even paid hunters cash rewards, or bounties for wolves that were shot. Another example is the sophisticated technology aids fishermen use to take ever increasing amounts of fish, leaving once abundant fisheries with smaller and smaller populations.

Non-native species can be introduced to an area creating additional problems that can disrupt the delicate

balance of an ecosystem. The introduced species may prey on the native species or disturb the habitat in unforeseen ways. In the South we do not have to look far to see the effects of the non-native species - Kudzu!

According to the World Wildlife Fund 137 species are estimated to go extinct each day and 50,000 species are estimated to go extinct each year. (2) Extinction is forever. What has been done in the past to help save species? What can we do as individuals to take responsibility for our actions now to help save species?

Solutions

In the early 1900s laws were passed to protect certain animals. It was not until 1973 when the U. S. government passed the Endangered Species Act (ESA) that the government set in motion its best effort to stop the loss of America's unique wildlife. This Act lists species that are in danger of becoming extinct. The Act makes it illegal to disturb, harass, harm, shoot, wound, kill, trap, pursue, capture, or collect any of the species on the list. The Act not only protects the listed species but also the habitat these creatures need in order to survive.

When scientists discover that a species is in danger of extinction ("endangered"), or in danger of becoming endangered ("threatened"), it is put on a list compiled by the U. S. Fish and Wildlife Service (FWS) and the National Oceanic and Atmospheric Administration B Fisheries (NOAA) The NOAA focuses on marine species only. These agencies are required to use the most rigorous science available to develop common sense solutions to prevent the extinction of listed species.

As of July, 2009, the U. S. Fish and Wildlife Service reported there are 571 animals on the list. Of the animals listed, 468 have a recovery plan in place. (3) These plans guide protection efforts toward arresting and reversing the decline in a species' population, and removing threats to that species' survival in the wild.

If information shows that a population of a threatened species is getting smaller, the species could be reclassified as an endangered species. If the population of an endangered species gets larger, it could be changed to a threatened species, or downlisted. If the population of a species increases large enough, it could be taken off the list entirely. There are many at-risk species that cannot be considered for listing until more research is done. The only way a species can be added to the list, removed from it, or reclassified is through an act of Congress.

When a species is listed, the government is required by law to designate its "critical habitat." The Act defines "critical habitat" as those geographical areas: that are essential for bringing an endangered or threatened species to the point where it no longer needs the legal protections of the Act; and which may require special management considerations or protection. (4) This critical habitat consists of those areas that must be managed to permit an endangered species to recover to a level where it is safe from the danger of extinction.

One of the central goals of the Act is the preservation of the ecosystems that the threatened or endangered species depends upon for their survival and recovery. By preserving the critical habitat it helps to ensure that other native species that rely on the same habitat do not also become threatened or endangered.

Strategies

The first strategy is to bring my students to an understanding that our backyards, our city, our state, our country and our earth is comprised of many different life forms that are highly interdependent. Through the introduction of environmental issues, ecology, ecosystems, food chains, food webs and interactions of organisms (including humans) we will explore systems to gain an understanding of the interconnectivity in the world in which we live.

The second strategy is to help my students understand the plight of endangered species and to gain a perspective on human activities that continue to impact endangered animals and threaten our global environment. To accomplish this, the students will work in groups to research selected or self-selected animals from the endangered species list. I have pre-selected six animals but some students might choose to do an independent study and choose another animal from the list.

All animals were selected because they are found in North Carolina. Three animals are currently listed on North Carolina's Endangered Species List. They are Red Wolf, Manatee and Eastern Cougar (puma). The Leatherback Sea Turtle is listed as threatened. The Bald Eagle and American Alligator were once listed and now are downlisted from the endangered list. These animals were selected because they are found within our state and they come from different classifications of the Endangered Species Act.

The class will be divided into six cooperative learning groups with each group being responsible to study in depth their particular animal and the animals' habitat. Students will use computers, books, articles, and video clips to learn about their animal. They will discuss their findings within their cooperative learning group. Students will individually create a Science Journal to record information, write creative stories, draw diagrams and pictures and record their reflections throughout the unit. Students will individually design a food chain incorporating their animal, and then share their food chain with their small groups, combining the chains to create a food web. Students will create a presentation (poster, transparencies, chart, power point) showing their animal and how it interacts with other animals in the food web. Each group of students will have the opportunity to share the information with their classmates.

Another strategy I will use is the use of simulation games. I will start by roping off a small portion of my room simulating encroachment. Each day I will increase the size of the roped off section until half of the room is off limits. We will discuss how it feels to only be able to use half of our classroom habitat. As a group we will discuss our feelings and then the students will reflect on the situation in their science journals. Through simulation games I want my students to become aware that human populations will grow and with that growth we will demand more land. The outcome of this growth is a threat to the habitats of animals and many other organisms.

During the course of this unit I will use hands on, minds engaged activities. One activity that the students will do in groups of four is an experiment where they will test different pollutants on water plants and record the outcome. Each group of students will receive five cups and five Elodea plants. They will label one cup the "control cup" and fill it with clean water and a plant. For each of the other cups they will select a specific pollutant, and place a fourth of a cup of that pollutant into the water then add the plant, carefully labeling each cup for clear identification. I will have a variety of pollutants for them to select from such as vegetable oil, motor oil, vinegar, salt, brown sugar, baking soda, pieces of plastic bag and peelings from fruit. I will then discuss both the important and vital role water plays in an ecosystem for all organisms and how human actions

have polluted the water. Acid rain, oil from cars, boats or spills, plastics floating in the water and salt from roads can all be discussed as the students make their predictions prior to their daily observations.

Another strategy I will use is a science center. The science center will contain books and articles on endangered animals, environmental issues, and ecology. I will also set up a demonstration experiment that will last for the duration of the unit. As a group we will discuss products that generate trash and I will ask each student to bring in a small piece of trash. I will place my 20 gallon aquarium in the center and fill it partially with soil. I will make a grid in the dirt and make a corresponding grid on a piece of paper with the name or description of each piece of the trash (making sure that someone brings plastics, a leaf, cardboard and styrofoam). When each student has placed their trash in the dirt grid I will cover all the trash with another layer of soil. We will keep the soil moist and make a class decision if we should add worms and mealworms to the soil. Students will be asked to recreate the grid in their journals and predict what they think will happen to the various pieces of trash.

After several weeks the students will dig up the trash, observe the results and write about the experiment in their journals. As a class we will discuss some various types of trash that are naturally recycled by nature, such as leaves, banana peels, and most paper. These materials are considered biodegradable due to the fact that nature can break them down and naturally recycle them. Students will compare the biodegradable materials with the non-biodegradable materials and discuss what happens to the materials that do not break down.

Through all of these strategies it is imperative that the students understand that their actions and voices can make a difference. I want my students to know that they can be a change agent and partner to keep endangered species from becoming extinct. I want them to know that as leaders in our school they can influence other students to become good stewards of our earth and become aware of simple changes they can personally make to recycle and reduce our contribution to pollution.

As a culminating activity each group will create/participate in at least two projects that promote awareness, support or directly effect endangered animals. Students will form self-selected groups of no more than three. Each group will then brainstorm ways in which they can inform and raise awareness of the human impact on our environment which leads to the reduction and damage of habitats. They will use their journals to review the lessons they have learned to help them pinpoint what the message is that they would like to share. They will also select an audience to share the message with (Kindergarten class, whole school, parents.) Students will then create a project (play, poster, power point, commercial, pamphlet, radio interview, rap, ect) and share their project with the audience they have selected.

The second project will be a self-selected action based project. The purpose of this project is for me to empower by students to take action and for the students to see themselves as having the ability to be agents of change. I want them to see that students in elementary school can make a difference in their own world.

For this project students will select from many options or develop their own "agent of change" project. Students might want to "adopt" an endangered bird of prey from our local Raptor Center where they can join in an organized program to save endangered species sponsored by our North Carolina Science Center. They can launch a petition to use real dinner plates instead of paper plates in our cafeteria, or encourage students to cut their consumption of paper towels every time they go to the restroom. They could train an "energy monitor" for each classroom who would be responsible for making sure lights were turned off when the class leaves the room. These are just a few examples of the projects the students might want to do in order to change their world!

Classroom Activities

Lesson One

Background

This activity will help students identify three essential components of a habitat which are food, water and shelter. They will also describe factors that influence carrying capacity which is the population size that the environment can sustain in the long term, given the food, habitat, water and other necessities available in the environment.

Limiting factors will also be defined as anything that tends to make it more difficult for a species to live and grow, or reproduce in its environment. Students will be able to give examples such as water, climate/weather, competition, predation, environmental pollution and habitat destruction as some of the factors. Students will also understand that ecological systems undergo constant change and that some fluctuations in response to a variety of limiting factors are natural in wildlife populations.

Materials

The materials needed for this activity are a large area, outside on the playground or gym, colored poker chips (red, blue and white) or squares of colored paper, science journals and a chart to record the data.

Activity

Before moving to the large area, explain the activity to the students. Select six students to be the red wolves, two students will be your helpers (later to become the hunters) and the rest of the students are the essential components of the habitat (food, water or shelter/space). The hand motion for shelter is to hold both hands over the head with finger tips touching forming a house shape (shelter) over your head. Shelters chip color is white. The hand motion for water is both hands over your mouth and the color chip is blue. The hand motion for food is both hands on your stomach and red chips represent food. Have students practice each of the hand motions correlated to the color of the poker chips.

Explain the rules of the activity. Students must stay inside of the designated habitat, students must walk, and students must stand with their backs to the opposite line until told to turn around. Explain that the activity will be played a number of times (10-15) depending on time frame and records will be kept in order to make a chart when we return to the room.

Take students to the designated area and line the wolves up on one side and the other students about twenty feet away from them. With the two lines facing away from each other, ask your helpers to pass by each student with the bowl of chips so that they can select what component they would like to be, or in the case of the wolves, to seek out. After each has selected ask the students to make their hand symbol that corresponds to their selected chip.

On the count of three the two lines turn around to face each other. Only the wolves are allowed to move. They walk to the other line and find a person with the same symbol as they have chosen. They touch that person on the shoulder then they both walk back to the line the wolves were on. If a wolf does not find the same symbol then he is no longer a wolf and remains on the component side and will select a component the next round.

During the second and third round the students will see that as the wolf population increases the essential components of their habitat decreases and fewer animals can survive. You can simulate a drought by taking all of the blue chips away from the essential components or a loss of habitat by taking most white chips away. A large snowfall could be shown by reducing the amount of prey (red chips). During the last few rounds let your helpers become hunters who stand in the middle of the two lines and try to touch as many wolves as possible as they walk by. This should lead to very few wolves, if any, that survive.

Upon returning to class have students draw a chart in their journals and log the number of rounds and the number of wolves for each round. For this assignment each round will stand for one year in the life of the wolf pack. Ask students to write in their journals how the information gathered simulates what occurs in the habitat of the wolves by taking the perspective of a wolf who survived most of the changes.

Ask for volunteers to read their stories to the class, listing on the board limiting factors as they come up in the stories. Discuss reasons why the wolves ended up on the endangered species list and what are some actions we can take to help them recover and to keep other animals from being added to the list. Ask the students to summarize some of the concepts they learned from this activity and add this new understanding to their journals. Use the following questions in a think, pair and share discussion. What do animals need to survive? How do these components influence carrying capacity? What are some "limiting factors" that affect the survival of animals? How do factors limiting carrying capacity affect the health, numbers and distribution of animals? Why is good habitat important for animals? Are wildlife populations static, or do they tend to fluctuate as part of an overall "balance" of nature? Is nature ever really in "balance" or are ecological systems involved in a process of constant change?

Lesson Two

Background

In the past humans have contributed to animals becoming endangered by using products that did what they were made to do but were not tested to see the long term effects on the environment. Tragic examples of this is DDT and PCBs (polychlorinated biphenyls) which are two dangerous persistent pollutants that accumulate in the fatty tissues of animals. As each small animal is eaten by an organism higher on the food chain, it accumulates the store of poison from its prey. This is called Biomagnification.

DDT is a pesticide that was sprayed on crops to kill insect pests. It is a manmade (manufactured) chemical that has a long half-life of about 50 years. It is now banned in most of the world, although India is beginning to manufacture and use it again to kill mosquitoes.

PCBs are also manufactured chemicals. They were primarily used in electrical transformers. They made their way into the environment through accidental spillage during manufacture and distribution as well as by illegal dumps of transformers. Although no longer produced, PCBs are extremely persistent in the environment.

Over its lifetime, a predator will eat many smaller food items, thus concentrating more of the poison in its tissues than any single prey item ever contained. As we look at the animals higher up the food chain, we observe higher concentrations of pollutants.

This exercise will simulate the concentration of pollutants through a food chain. Although we will first look at an entire food chain, the simulation will be limited to three steps of the food chain. Students will discover how interrelationships between organisms (including humans) affect each other.

Materials

In preparation of this activity we will need a bag of colored Goldfish crackers. These will represent minnows in the activity. Each student will need a container (brown lunch bag) to place his "minnows" in and a name tag designating them as either an Eagle or a trout. Students will use index cards, whole punch and string to make their identification tags. I will choose two students who have lots of energy to be my Eagles, the rest of the class will be trout. If there is a student who is uncomfortable with the active part of the lesson, I will ask them to be the "Wildlife Agent" and keep track of the information on a chart.

I will also make copies of the Eagles food chain found at <http://www.learner.org/jnorth/tm/eagle/FoodChainDrawings.html> (one for each team of two) and cut them into cards. I will show the students an example of an energy pyramid using my computer and LCD projector. The web site I will use is <http://www.earthforce.org/content/article/detail/1284>

Activity

This lesson will take place after students have selected specific animals and have created an individual food chain and collective food web for their animals. To engage the students each pair will work together to place the Eagle food chain cards in the correct order. We will then discuss the food chain. We will discuss key questions such as what would happen if one of the organisms' population was reduced, if the water became contaminated, and how humans affect the food chain.

I will then introduce the concept of an energy pyramid through the use of a poster located on the web. Students will create an energy pyramid in their journals. I will use the visual to point out to the students the large number of individual organisms at the bottom of the pyramid and how the size and energy needs increase toward the top of the pyramid. Biomagnification will also be introduced through the discussion of the energy pyramid.

Following the discussion, students will be ready to participate in the activity. Students will put on their nametags (eagle or trout) and we will go outside to a designated location. I will set the boundaries of the "pond" and the location of the eagles' nests. I will explain the rules of the activity. Only walking is permitted.

Eagles need to catch one trout at a time and bring that trout back to the nest so that they can feed their babies. When caught, the trout must go willingly back to the nest with the eagle where they are "eaten" and can not swim away. The caught trout will stay at the nest until the activity is finished.

When the eagles are at their nests and the trout are in the pond with their containers I will run through the "pond" distributing the minnows (Goldfish) all over the ground. The trout will scramble to pick up as many minnows as they can. After all minnows are scattered, tell the eagles to start hunting. When the eagles have caught all the trout the students will be in two groups holding their bags of minnows. Have students line up according to the number of minnows they caught then record the number of minnows each trout ate, how many trout each eagle ate, and the total about of minnows (through eating the trout) each eagle consumed.

Upon returning to the class explain to the class that each minnow (Goldfish) contained 0.5 ppm (parts per million) of DDT. Although each trout needed to eat the minnows to sustain life the pesticide contained within the minnows could adversely affect the trout since it accumulated in their fat. Then direct the students attention to the eagles and how much they acquired by eating the trout. Also discuss how the off spring of the eagles faired. Remembering that the eaglets are small but consuming DDT from their parents, through the

trout.

Lesson Three

Background

In the past forty years the world population has doubled. In the year 2000 the world population reached six billion. Most of the growth takes place in developing countries. Population growth leads to the loss of natural habitat.

The United States has a total resident population of 305 million. It is an urbanized nation, with 81% of the population residing in cities and suburbs. Population and economic growth in urban centers has been increasing pressures on ecosystems. Dense urban settlement is considered to be a lesser burden on the environment than urban and suburban sprawl. Human population growth and the consumption of open space and resources destroy habitat required by wildlife for survival. Human development can disturb whole ecosystems, often irreparably.

Important wildlife habitat is rapidly lost or fragmented in the course of urban development, oil and gas extraction, and the conversion of land to agricultural uses. Some of the damage to wildlife is visibly the result of humans encroaching on wildlife habitat. An example is the loss of habitat for reptiles, rodents, birds, and mammals as they clear cut all the trees to construct a new subdivision. The trees that are cut down also were oxygen producers and CO₂ eliminators. With the clear cut subdivision new homes for humans can be built less expensively, but a large cost to the biodiversity of our earth.

Materials

For this activity students will work in pairs to create a habitat. Each group will need a large (12x18) piece of construction paper that will represent their habitat (assortment of colors to represent different habitats. Students will need a wide selection of small plastic animals or they can create their own from construction paper. Blue paper will be needed to represent water. Brown bags or medium size pieces of construction paper will represent the human's use of the habitat. Scissors, glue, and crayons will also be placed on the distribution table to be used as needed by the students.

Activity

Working in pairs the students will agree on a habitat to represent. Using the provided materials the students will create a habitat for several animals keeping, in mind the needs of the animals (food, water, shelter, space.) I will divide the pairs of students into two groups. The first group will take turns visiting and asking questions of the second groups projects, then we will reverse the roles. During writing time students will write in their journals how and why they selected their animals and their habitat.

The next day I will give the students a small size brown bag or a piece of paper and tell them that this represents a new hotel that has just been built on their land. Students will then redesign their habitat to incorporate the new building, roads and support structures to accommodate the hotel on their land. When the pair has finished one student will take the perspective of the hotel owner and the other will take the perspective of one of the animals. They will each write a story and tell what happened to them from their assigned point of view. When they have finished the writing assignment they will share their story with each other. I will then divide the class into hotel owners and animals and we will hold a town meeting (debate) to

discuss the benefits and disadvantages of the new hotel.

The next day we will explore ways the hotel could be built in an environmentally friendly way. We will discuss renewable and nonrenewable resources and what part renewable resources could play in the building of the hotel. We will discuss responsible ways to reduce water and air pollution.

As we focus on positive solutions to humans and animals living in close proximity I will guide the discussion to what we as individuals can do to help the endangered animals from becoming extinct. I want my students to feel empowered to make a difference in their world through taking personal responsibility in both small and large ways.

Appendix

Implementing District Standards

Figure 1- North Carolina Standard Course of Study

Science — Grade 5

Goal 1 The learner will conduct investigations to build an understanding of the interdependence of plants and animals.

Objective 1.01 Describe and compare several common ecosystems (communities of organisms and their interaction with the environment).

Objective 1.02 Identify and analyze the functions of organisms within the population of the ecosystem. Students will know which organisms are producers, consumers, and decomposers.

Objective 1.03 Explain why an ecosystem can support a variety of organisms.

Objective 1.04 Discuss and determine the role of light, temperature, and soil composition in an ecosystem's capacity to support life.

Objective 1.05 Determine the interaction of organisms within an ecosystem.

Objective 1.06 Explain and evaluate some ways that humans affect ecosystems. Examples are habitat reduction due to development, pollutants, and increased nutrients caused by fertilization.

Objective 1.07 Determine how materials are recycled in nature.

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Contains 25 environmental projects that can be used with students.

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them.

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I will use this book after we the Red Wolf activity. Awesome pictures!

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Notes

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